

CLAIMS

What is claimed is:

1 1. A fiber optic module comprising:
2 a pull-actuator to disengage and withdraw the fiber optic
3 module from a cage assembly; and
4 one or more electro-optic transducers to convert optical
5 signals into electrical signals or electrical signals into
6 optical signals.

1 2. The fiber optic module of claim 1 wherein
2 the fiber optic module is a small form pluggable (SFP)
3 fiber optic module and the cage assembly is a small form
4 pluggable (SFP) cage assembly.

1 3. The fiber optic module of claim 1 wherein
2 the pull-actuator is activated to disengage and withdraw
3 the fiber optic module by a single backward pull action.

1 4. The fiber optic module of claim 1 wherein
2 the pull-actuator includes one or more grooves to
3 slideably engage the fiber optic module.

1 5. The fiber optic module of claim 1 wherein
2 the fiber optic module includes one or more grooves to
3 slideably engage the pull-actuator.

1 6. The fiber optic module of claim 1 wherein
2 the pull-actuator slides to disengage the fiber optic
3 module from the cage assembly.

1 7. The fiber optic module of claim 1 wherein
2 the pull-actuator includes,
3 one or more end-stops to withdraw the fiber optic
4 module as the pull-actuator is pulled.

1 8. The fiber optic module of claim 1 wherein
2 the pull-actuator includes
3 one or more end-stops to prevent the pull-actuator
4 from becoming disengaged from the fiber optic module as it is
5 pulled.

1 9. The fiber optic module of claim 1 wherein
2 the pull-actuator includes
3 a pull-tab,
4 a shaft coupled to the pull tab at a first end, and
5 an opening at a second end of the shaft to engage a
6 first end of a pivot arm.

1 10. The fiber optic module of claim 1 wherein the pull-
2 actuator includes
3 an orientation indicator to indicate the fiber optic
4 module which the pull-actuator releases.

1 11. The fiber optic module of claim 1 wherein
2 the pull-actuator is formed of metal.

1 12. The fiber optic module of claim 1 wherein
2 the pull-actuator is formed of a plastic.

1 13. The fiber optic module of claim 1 further
2 comprising:

a pivot-arm actuator, pivotally coupled to the fiber optic module, to release the fiber optic module from the cage assembly when the pull-actuator is pulled.

14. The fiber optic module of claim 13 wherein the pivot-arm actuator further includes, a pivoting pin to rotationally couple the pivot-arm actuator to the fiber optic module.

15. The fiber optic module of claim 13 wherein the pivot-arm actuator includes a first engaging end to engage to the cage assembly, a second engaging end to engage to the pull-actuator, and a shaft coupling to the first and second engaging ends.

16. The fiber optic module of claim 15 wherein the first engaging end includes a keeper to engage the fiber optic module to the cage assembly.

17. The fiber optic module of claim 15 wherein the first engaging end includes a latch to engage the fiber optic module to the cage assembly.

18. The fiber optic module of claim 15 wherein the second engaging end includes a keeper to engage the pivot-arm actuator to the pull-actuator.

19. The fiber optic module of claim 15 wherein the second engaging end includes a latch to engage the pivot-arm actuator to the pull-actuator.

1 20. The fiber optic module of claim 15 wherein
2 the second engaging end includes a ramped sliding surface
3 to slide and cause the pivot-arm actuator to rotate when the
4 pull-actuator is pulled.

1 21. The fiber optic module of claim 13 further
2 comprising:
3 a spring to cause the pivot-arm actuator to return to its
4 initial position when the pulling force on the pull-actuator
5 is removed.

1 22. The fiber optic module of claim 21 wherein
2 the spring is a leaf spring and part of the pivot-arm
3 actuator.

1 23. The fiber optic module of claim 21 wherein
2 the spring causes the pull-actuator to return to its
3 initial position when the pulling force on the pull-actuator
4 is removed.

1 24. The fiber optic module of claim 1 wherein the pull-
2 actuator permits arranging multiple fiber optic modules in a
3 belly-to-belly configuration without obstructing adjacent
4 pull-actuators.

1 25. The fiber optic module of claim 24 wherein with the
2 belly-to-belly configuration, two pull-actuators are located
3 in proximity to each other along a common surface between two
4 fiber optic modules.

1 26. A pull-actuator for fiber optic modules. the pull-

2 actuator comprising:
3 a pull-tab;
4 a pull-arm coupled to the pull-tab at a first end; and
5 a catch at another end of the pull-arm to latch to a
6 second actuator.

1 27. The pull-actuator of claim 26 wherein
2 the pull-actuator slides to cause the second actuator to
3 disengage a fiber optic module from a cage assembly.

1 28. The pull-actuator of claim 26 wherein pulling the
2 pull-actuator causes the second actuator to release a fiber
3 optic module from a cage assembly.

1 29. The pull-actuator of claim 26 wherein
2 the pull-actuator includes one or more grooves to
3 slideably engage a fiber optic module.

1 30. The pull-actuator of claim 26 wherein
2 the pull-actuator includes
3 one or more end-stops to withdraw a fiber optic
4 module as the pull-actuator is pulled.

1 31. The pull-actuator of claim 26 wherein
2 the pull-actuator includes
3 one or more end-stops to prevent the pull-actuator
4 from becoming disengaged from a fiber optic module as it is
5 pulled.

1 32. The pull-actuator of claim 26 wherein the pull-tab
2 includes an orientation indicator to indicate a fiber optic
3 module which the pull-actuator releases.

1 33. The pull-actuator of claim 26 wherein the second
2 actuator is a pivot-arm actuator which pivots to disengage a
3 fiber optic module from a cage assembly when the pull-actuator
4 is pulled.

1 34. The pull-actuator of claim 26 wherein the pull-
2 actuator permits arranging multiple fiber optic modules in a
3 belly-to-belly configuration without obstructing adjacent
4 pull-actuators.

1 35. The pull-actuator of claim 34 wherein with the
2 belly-to-belly configuration, two pull-actuators are located
3 in proximity to each other along a common surface between two
4 fiber optic modules.

1 36. A pivot-arm actuator for fiber optic modules having
2 one or more electro-optic transducers, the pivot-arm actuator
3 comprising:

4 a pivot arm which causes a fiber optic module to be
5 released from a cage assembly when a pull-actuator is pulled;
6 and

7 a pivoting pin to rotationally couple the pivot arm to a
8 fiber optic module.

1 37. The pivot-arm actuator of claim 36 wherein the pivot
2 arm includes,

3 a first engaging end with a keeper to engage a fiber
4 optic module to a cage assembly.

1 38. The pivot-arm actuator of claim 36 wherein the pivot
2 arm includes,

3 a first engaging end with a latch to engage a fiber optic
4 module to a cage assembly.

1 39. The pivot-arm actuator of claim 36 wherein the pivot
2 arm includes,
3 a second engaging end, opposite the first engaging end,
4 with a keeper to engage the pivot-arm actuator to a pull-
5 actuator.

1 40. The pivot-arm actuator of claim 36 wherein the pivot
2 arm includes,
3 a second engaging end, opposite the first engaging end,
4 with a latch to engage the pivot-arm actuator to a pull-
5 actuator.

1 41. A pull de-latch mechanism for fiber optic modules,
2 the pull de-latch mechanism comprising:
3 a pull-actuator; and
4 a pivot-arm actuator coupled to the pull-actuator at a
5 first end, wherein pulling the pull-actuator causes the pivot-
6 arm actuator to rotate thereby releasing a fiber optic module
7 from a cage assembly.

1 42. The pull de-latch mechanism of claim 41 wherein the
2 pivot-arm actuator includes
3 a ramped sliding surface at the first end which causes
4 the pivot-arm actuator to rotate when the pull-actuator is
5 pulled thereby releasing a fiber optic module from a cage
6 assembly.

1 43. The pull de-latch mechanism of claim 41 wherein the
2 pivot-arm actuator includes
3 a keeper at a second end, opposite the first end, to

4 couple the fiber optic module to a cage assembly.

1 44. The pull de-latch mechanism of claim 41 wherein
2 the pull-actuator includes
3 an orientation indicator to indicate the fiber optic
4 module which the pull-actuator releases.

1 45. The pull de-latch mechanism of claim 41 wherein,
2 the pull-actuator includes grooves to slideably engage a
3 fiber optic module.

1 46. The pull de-latch mechanism of claim 41 wherein
2 the pull-actuator includes
3 one or more end-stops to withdraw the fiber optic
4 module as the pull-actuator is pulled.

1 47. The pull de-latch mechanism of claim 41 wherein
2 the pull-actuator includes
3 one or more end-stops to prevent the pull-actuator
4 from becoming disengaged from the fiber optic module as it is
5 pulled.

1 48. The pull de-latch mechanism of claim 41 wherein the
2 pull de-latch mechanism permits arranging multiple fiber optic
3 modules in a belly-to-belly configuration without obstructing
4 adjacent pull de-latch mechanism.

1 49. The pull de-latch mechanism of claim 48 wherein the
2 belly-to-belly configuration two pull-actuators are located in
3 proximity to each other along a common surface between two
4 fiber optic modules.

1 50. A fiber optic module comprising:
2 means for converting optical signals into electrical
3 signals or electrical signals into optical signals; and
4 means for disengaging the fiber optic module from a cage
5 assembly by pulling a pull-actuator.

1 51. The fiber optic module of claim 50 further
2 comprising:
3 means for slideably engaging the means for disengaging
4 the fiber optic module.

1 52. The fiber optic module of claim 50 wherein the means
2 for disengaging also provides a means for withdrawing.

1 53. The fiber optic module of claim 50 further
2 comprising:
3 means for withdrawing the fiber optic module.

1 54. The fiber optic module of claim 50 further
2 comprising:
3 means for pivotally disengaging the fiber optic module
4 from a cage assembly when the pull-actuator is pulled.

1 55. The fiber optic module of claim 54 further
2 comprising:
3 means for coupling the pivotally disengaging means to the
4 fiber optic module.

1 56. The fiber optic module of claim 50 further
2 comprising:
3 means for indicating the fiber optic module which the

means for disengaging releases.

57. A method for disengaging and withdrawing a fiber optic module from a cage assembly comprising:
pulling a pull-actuator to disengage the fiber optic module from the cage assembly; and
continuing to pull on the pull-actuator to withdraw the fiber optic module from the cage assembly.

58. The method of claim 57 comprising:
releasing the pull-actuator if the fiber optic module has been released from the cage assembly.

59. A fiber optic module comprising:
a nose receptacle including
a fiber optic cable receptacle to receive one or more fiber optic cable plugs,
a pull-actuator to release the fiber optic module from a cage assembly using a pull action;
a pivot-arm actuator coupled to the pull-actuator, the pivot-arm actuator to pivot and release a keeper from a latch to release the fiber optic module in response to a pull action on the pull-actuator; and
a printed circuit board including one or more electro-optic transducers to convert optical signals into electrical signals or electrical signals into optical signals.

60. The fiber optic module of claim 59 wherein,
the fiber optic module is a small form pluggable (SFP) fiber optic module and the cage assembly is a small form pluggable (SFP) cage assembly.

61. The fiber optic module of claim 59 further

2 comprising:

3 a housing to couple to the nose receptacle and cover the
4 printed circuit board.

1 62. The fiber optic module of claim 61 wherein,
2 the housing is shielded to protect the printed circuit
3 board from electromagnetic interference.

1 63. The fiber optic module of claim 59 wherein,
2 the pull-actuator includes one or more grooves to
3 slideably engage the nose receptacle.

1 64. The fiber optic module of claim 59 wherein,
2 the pull-actuator slides outward to release the fiber
3 optic module from the cage assembly.

1 65. The fiber optic module of claim 59 wherein,
2 the pivot-arm-actuator includes
3 a pivot pin rotationally coupled to the nose receptacle
4 at first and second ends to allow the pivot-arm actuator to
5 pivot.

1 66. The fiber optic module of claim 59 wherein
2 the nose receptacle further includes
3 a spring coupled to the pivot-arm-actuator at a first end
4 and the nose receptacle at a second end, the spring to exert a
5 force on the pivot-arm-actuator to exert a return force on the
6 pull-actuator.

1 67. The fiber optic module of claim 59 wherein,
2 the pull-actuator includes
3 an orientation indicator to indicate the fiber optic

4 module which the pull-actuator releases.

1 68. The fiber optic module of claim 59 wherein,
 2 the pull-actuator includes
 3 a pull-tab,
 4 a shaft coupled to the pull-tab at a first end, and
 5 a catch at a second end of the shaft.

1 69. The fiber optic module of claim 59 wherein,
 2 the pull-actuator is located at a bottom side of the
 3 fiber optic module.

1 70. The fiber optic module of claim 59 wherein,
 2 the nose receptacle further includes
 3 a grip to pull out on the fiber optic module.

1 71. A configuration of fiber optic modules having one or
 2 more electro-optic transducers, the configuration comprising:
 3 a printed circuit board having a first side and a second
 4 side;
 5 a first cage coupled to the first side of the printed
 6 circuit board to receive a first fiber optic module; and
 7 a second cage coupled to the second side of the printed
 8 circuit board to receive a second fiber optic module, the
 9 second cage aligned in parallel to the first cage such that a
 10 first belly of the first fiber optic module is adjacent a
 11 second belly of the second fiber optic module.

1 72. The configuration of claim 71 wherein,
 2 the first belly of the first fiber optic module being
 3 adjacent to the second belly of the second fiber optic module
 4 provides for increased density.

73. The configuration of claim 71, further comprising:

- the first fiber optic module having a first pull-actuator with a first orientation indicator;
- the second fiber optic module having a second pull-actuator with a second orientation indicator; and
- the first pull-actuator and the second pull-actuator each having a pull-tab offset from each other when the first belly is adjacent the second belly.

1 75. The configuration of claim 73 wherein,
2 the pull-tab is a pull button.

1 77. The configuration of claim 73 wherein,
2 the pull-tab is a pull hook.

1 79. The configuration of claim 73 wherein,
2 the pull-tab is a pull square.